

Care of the Well Newborn

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Objectives After completing this article, readers should be able to:

1. Understand the unique features of the physiology of the newborn and how care of the infant addresses these elements.
2. Know the physical and behavioral characteristics of full-term and post-term infants.
3. Understand the elements involved in feeding the neonate, as well as ways breastfeeding can be encouraged.
4. Be aware of optimal hospital policies in caring for newborns, including the concept of family-centered care.
5. Understand the management of common problems encountered in care of the newborn, such as jaundice, passage of meconium before birth, and respiratory distress.
6. Be aware of preventive measures in care of the newborn: administration of vitamin K, eye prophylaxis, anticipatory guidance.

Introduction

The birth of an infant is a time of great joy but also a time of significant change for families. Typically, a large amount of historical information is collected, new data are integrated, and synthesized knowledge is taught to parents during a brief hospitalization surrounding an infant's birth. Family routines are in flux and complex physiologic changes are occurring in both the mother and infant. In the midst of this time of great transition, clinicians should remember that care of the family should be accessible, continuous, comprehensive, family-centered, coordinated, compassionate, and culturally effective. The concept of a medical home starts for the child at the prenatal visit and extends through the birth and beyond, when a clinician and family begin a relationship to promote healthy growth and development. The principles of the medical home are described in Fig 1. (1)

Antenatal Care

Stated simply, the goals of antenatal care are to prevent maternal and neonatal complications associated with pregnancy and childbirth. This care should be cost-effective and evidence-based. Care should focus on maternal risk factor identification and reduction, as well as patient education. Finally, antenatal care should be available to all women, regardless of their socioeconomic or insurance status.

Ideally, antenatal care starts before conception, with healthy lifestyle choices and guidance from primary care clinicians regarding the importance of folic acid supplementation; smoking cessation; attention to and treatment of mental health disorders; and importance of exercise, diet, and ideal body weight. Once pregnant, women seek care from a variety of maternity care providers: nurse midwives, family physicians, obstetricians, and maternal-fetal medicine specialists. Regardless of discipline, a chosen maternity care provider then meets a woman and her partner/family, establishes a relationship, and sets expectations for the pregnancy and birth.

Abbreviations

GBS:	group B streptococcal
LGA:	large for gestational age
SGA:	small for gestational age
Tdap:	tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed
TTN:	transient tachypnea of the newborn
USPSTF:	US Preventive Services Task Force

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Personal physician
<i>Patients have ongoing relationships with personal physicians who provide continuous and comprehensive care.</i>
Physician-directed medical practice
<i>Personal physicians lead a team of health care providers at the clinic level who have a collective responsibility for the ongoing care of each patient.</i>
Whole-person orientation
<i>Personal physicians and their health care teams provide or assist patients in obtaining the health care services needed.</i>
Care is coordinated and/or integrated
<i>Care is coordinated and facilitated across complex health systems and the patient's community to ensure patients get the care they need, when and where they need it, in a culturally and linguistically appropriate manner.</i>
Quality and safety
<i>Physician-directed practices are accountable for continuous quality improvement, use of evidence-based medicine to guide decision making, and appropriate use of medical technology. These practices engage patients and their families in processes to ensure patients receive the best possible health care.</i>
Enhanced access
<i>Patients can access health care services when they need them. Practices should be creative in providing new options for communication between patients and their health care teams.</i>
Payment
<i>Increased payments support the added value of care available and provided to patients who have a patient-centered medical home.</i>

Figure 1. Principles of the patient-centered medical home. Issued jointly by the American Academy of Family Physicians, the AAP, the American College of Physicians, and the American Osteopathic Association, 2007. Adapted from Kellerman R, Kirk L. Principles of the patient-centered medical home. *Am Fam Physician*. 2007;76:774–775.

The first few visits in early pregnancy should focus on establishing early pregnancy dating (via last menstrual period or early ultrasound) as well as risk factor identification. Comprehensive review and documentation of the maternal medical history (including medication and supplement use), obstetric and gynecologic history, family history, genetic history, and social/occupational history are critical to providing comprehensive care. Screening for substance abuse, mental health disorders, and domestic violence are just as important in the care of the maternal/fetal dyad as routine prenatal laboratory analysis.

Many women (now regardless of age) opt for early genetic screening in the first trimester of pregnancy with blood testing (maternal serum pregnancy-associated plasma protein A and β -human chorionic gonadotropin) coupled with ultrasound to measure the nuchal translucency of the fetus. In the second trimester, a maternal blood test for alpha fetoprotein is added, and the results are integrated from both tests, giving pregnant women a numerical risk of carrying a fetus with aneuploidy or open spina bifida. In addition, nearly all women are offered a detailed anatomy screening ultrasound in their second trimester of pregnancy.

Given the explosion of use and the increasing sensitivity of these technologies, antenatal visits may be used to discuss

and plan for necessary follow-up of suspicious prenatal ultrasound findings, such as prenatal hydronephrosis, single umbilical arteries, or other abnormalities. In these and more complicated situations, it may be necessary for the maternity care and pediatric provider to communicate and coordinate a variety of specialists before birth and develop a neonatal care plan both for the birth and immediately thereafter.

Integration of the Electronic Health Record

The infant's primary care provider after hospital discharge will not always care for the neonate during the birth hospitalization. Increasingly, hospital-based clinicians care for newborns during this period, then transition care to outpatient pediatric care providers.

Given the myriad disciplines that provide antenatal outpatient maternity care, as well as the variety and scope of intrapartum care clinicians,

obtaining an accurate and comprehensive maternal and family history to guide neonatal care can be an incredible challenge. Electronic health records afford the opportunity to link maternal and infant records and integrate medical care. Currently, these electronic health record systems are largely still a work in progress at many institutions and linking office-based systems with hospital-based systems still may pose challenges.

Robust maternal risk factor identification and documentation, laboratory and imaging data during pregnancy, and comprehensive documentation of labor course and delivery in a linked electronic medical record provides the essential information needed for neonatal clinicians to determine the infant's appropriate medical care after birth.

Early Postpartum Period Transitioning

Labor and delivery is a physiologically stressful environment for both the mother and neonate. Maternity care providers commonly use electronic fetal monitoring as a tool when evaluating fetal well being during the labor process; however, there is little evidence that continuous electronic fetal monitoring in low-risk pregnancies improves outcomes. Uterine contractions decrease blood flow to the fetus. A healthy fetal-placental unit will allow

the fetus to maintain a normal heart rate though this uterine contraction. If there is uteroplacental insufficiency, however, the fetal heart rate often shows characteristic changes (eg, late decelerations) that may prompt an expedited vaginal delivery or cesarean delivery.

Both the timing and mode of deliveries are changing. In 1996, the cesarean birth rate in the United States was 20.7%; in 2006, this rate was 31.1%. Much of this increase reflects a decrease in the rate of attempted vaginal birth after cesarean delivery, with an increase in either primary elective or scheduled repeat cesarean deliveries. Infants born before 39 weeks of gestation in general are at risk for adverse outcomes, particularly transient tachypnea of the newborn (TTN).

Tita et al (2) showed elective cesarean deliveries before 39 weeks' gestation (but >37 weeks' gestation) were associated with increased rates of adverse respiratory outcomes, mechanical ventilation, newborn sepsis, hypoglycemia, NICU admissions, and hospitalizations at birth for more than 5 days. Tutdibi et al (3) confirmed the strong association between TTN and elective cesarean delivery and further demonstrated elective cesarean delivery at term gestation (>37 weeks) in the absence of fetal exposure to labor contractions is associated with an increased risk of and more severe course of TTN. In this same group, infants born vaginally or via cesarean after a labor course showed no increased risk for TTN. For these reasons, and for infant neurodevelopment, the March of Dimes Healthy Babies are Worth the Wait™ (http://marchofdimes.com/pregnancy/getready_atleast39weeks.html) campaign encourages waiting until at least 39 0/7 weeks' gestation for elective labor induction or cesarean.

Obstetric analgesia and anesthesia are other important considerations for the neonatal care clinician. Options for pain control during labor and delivery include local anesthesia, parenteral analgesia (usually in the form of fentanyl, morphine, or nalbuphine), inhaled anesthetics (nitrous oxide), regional analgesia/anesthesia (epidural, spinal, combined spinal/epidural), and general anesthesia. Each has its own risks and benefits. Labor epidurals have become more common, and trials randomizing women to epidural analgesia or parenteral medications

have shown an increased rate of maternal fever in the epidural groups (relative risk 4.0–4.6). (4) The mechanism currently is not known, and although there has been no demonstrated increased risk of neonatal sepsis, there has been an increase in neonatal sepsis evaluations.

Early Assessments

In the immediate postpartum period, the newborn care team (usually a nurse and birth attendant) is responsible for attending to any needs for neonatal resuscitation. Approximately 10% of all neonates require some form of resuscitation. Standard Neonatal Resuscitation Program guidelines are comprehensive and evidence-based standards, which direct any necessary resuscitation. (5) All birth attendants should be familiar with neonatal resuscitation algorithms, equipment, and resources available in their practice settings. Team simulation-based trainings and certifications are becoming increasingly common and help maintain infrequently used skills.

Management of neonates at birth when meconium is present has changed in the past few years. If an infant is born vigorous, no suction or further exploration of the oropharynx or trachea is indicated. In the presence of meconium and a nonvigorous neonate, an attempt at visualization of the vocal cords with suction should be performed, but should not significantly delay any further resuscitative needs (such as positive pressure ventilation).

Apgar score assignment is a standardized way to communicate the clinical status of a newborn infant. The score traditionally is assigned at 1 and 5 minutes of life, but may be continued every 5 minutes as dictated by the clinical context. The score has five components: heart rate, respiratory effort, muscle tone, reflex irritability, and color. Each component is given a score of 0, 1, or 2 (see Table 1). A 5-minute Apgar score of 7 to 10 is considered normal. Apgar scores can be helpful in assessing an infant's transition from intrauterine to extrauterine life and may reflect neonatal resuscitation efforts, but should not guide these efforts. Likewise, Apgar scores should not be used to predict neurologic outcomes or development of infants. Common

Table 1. The Apgar Score

The Apgar Score	0	1	2
Heart rate	Absent	<100 beats per min	>100 beats per min
Respiratory effort	Absent	Weak cry; hypoventilation	Good cry
Muscle tone	Flaccid	Some flexion	Active motion/Well flexed
Reflex irritability	No response	Grimace	Cry/Cough/Sneeze
Color	Blue/Pale	Acrocyanotic	Completely pink

limitations to Apgar scoring include prematurity, congenital anomalies, exposure to drugs, and hypovolemia. (6)

Cord blood gas assessments provide more physiologic information on the neonate than Apgar scores. The most objective assessment of intrapartum hypoxia-ischemia is the presence of metabolic acidosis in umbilical arterial blood at the time of birth. (7) During normal labor, umbilical arterial pH drops and base deficit rises. Healthy term infants have an umbilical arterial pH of 7.27 ± 0.07 and base deficit of -2.7 ± 2.8 mM. A pure respiratory acidosis can be corrected rapidly by the neonate or by administering positive pressure ventilation at an appropriate rate. Neonates are unable to correct a metabolic acidosis quickly, however; thus, an umbilical arterial pH of <7.0 or base deficit >12 mM suggests increased risk (but not certainty) of neonatal neurologic morbidity.

Every effort should be made to promote skin-to-skin contact with the mother directly after birth for the stable infant. Newborns have a high surface area-to-body ratio, and thus are prone to heat loss. Infants who are cold become stressed and rapidly deplete their stores of fat and glycogen. The infant should be encouraged to breastfeed as soon as possible and within the first hour of birth. If skin-to-skin contact is not sufficient for a newborn to maintain his or her temperature, swaddling and the use of a radiant warmer in the delivery room are additional resources. The administration of standard newborn medications, such as erythromycin eye ointment and vitamin K, is another priority in the first hours of life.

Vitamin K is an important clotting factor synthesized by intestinal bacteria. All neonates are born with low levels of vitamin K because of the absence of gut flora but also because of low levels of transplacental passage and the inability of the fetal liver to store vitamin K. Vitamin K-deficient bleeding (formerly known as hemorrhagic disease of the newborn) can occur directly after birth or many weeks later, presenting as skin bruising, mucosal bleeding, bleeding at the umbilicus and circumcision site, or even fatal intracranial hemorrhage. Large hematomas at injection sites or on the head after delivery also may be presenting signs.

Maternal risk factors for the infant's development of vitamin K-deficient bleeding include antiepileptic, antituberculin, and vitamin K antagonist medications. Human milk is a poor source of vitamin K, and infants with late hemorrhagic disease of the newborn often are those who are breastfed and did not receive vitamin K at birth. Vitamin K given to all babies after delivery in an intramuscular injection has been shown to prevent both early and late forms of bleeding. There is not enough information about the efficacy of oral vitamin K to recommend

its routine use, although it is certainly better to use oral vitamin K than none at all when parents refuse the intramuscular formulation. There is no proven relationship between vitamin K administration and childhood cancer.

Erythromycin is the most commonly used medication to prevent ophthalmia neonatorum from *Neisseria gonorrhoeae* and *Chlamydia trachomatis* and is applied to the infant's conjunctival sacs immediately after birth. Silver nitrate can be used but is less effective against *Chlamydia* and frequently causes a chemical conjunctivitis. Many developing countries use povidone iodine. A recent national shortage of erythromycin in the United States highlighted the need to identify an effective, inexpensive alternative to erythromycin, establish stores, or enhance production capability of erythromycin.

The initial newborn assessment, including a thorough examination of the infant for any anomalies and identification of infant and maternal risk factors necessitating further evaluation, typically is performed by a labor and delivery nurse or the birth attendant for low-risk deliveries. For higher-risk deliveries, a specialized neonatal resuscitation team may be present at the delivery and perform this assessment.

Assessing Growth and Gestational Age

At birth and as a child grows and develops, one of the most important things pediatric clinicians do is measure, record, and assess growth. This process starts at birth with basic measurements, including weight, head circumference, and length. The infant's measurements are plotted on a growth curve according to gestational age. Infants who fall outside the normal weight range qualify as small for gestational age (SGA) or large for gestational age (LGA). SGA and LGA sometimes are defined as <10 th percentile and >90 th percentile, respectively, for gestational age, but also may be described as less than or greater than two SDs around the mean. Intrauterine growth restriction describes an infant whose growth is limited compared with his or her potential because of environmental, genetic, or other factors. All of these characterizations are important because they identify at-risk newborns.

The measurements for head circumference also require careful attention to detail and can indicate micro- or macrocephaly. The infant who is small but has preserved head size (asymmetric growth restriction) frequently has poor growth because of nutritional factors (placental insufficiency), whereas genetic conditions, environmental factors such as toxins, and congenital infections should be considered when the infant is symmetrically small with

microcephaly. These birth parameters are important to communicate to the follow-up care provider for future comparisons. There is some evidence that the current growth curves commonly used in newborn care require updating with our contemporary and genetically diverse population.

When the gestational age or due dates are uncertain, a gestational age assessment is completed using the Dubowitz/Ballard examination. (8)(9) Using such a tool, the clinician assesses the infant's neuromuscular and physical maturity using a standardized examination. Neuromuscular maturity is based on the infant's neuromuscular tone and reflexes; physical maturity assessments include the anterior-posterior progression of plantar creases and progression from transparency to cracking, the presence or absence and amount of lanugo, the extent of development of breast tissue, eye and ear development, and maturation of the genitalia. Scores are assigned for neuromuscular and physical characteristics. These scores are then combined to arrive at a maturity rating score approximating the newborn's gestational age in weeks. This method of estimating gestational age is especially important for premature infants; however, each clinician should formally or informally assess each individual infant and determine whether the stated gestational age is supported by the physical examination.

The definition of the term infant is an infant born between 37 0/7 weeks' and 42 0/7 weeks' gestation. Every week of maturation is important, however, and many infants who qualify as "term" by gestational duration will encounter problems uncharacteristic of newborns delivered at 40 weeks' gestation. Fetal development during gestation is a continuum just as it is after birth. In particular, the vulnerability of the late preterm infant (34 0/7 to 36 6/7 weeks' gestation) is being recognized increasingly and pediatric clinicians should take special care with this population of newborns. (10)

Care Pathways

Newborn care in hospitals often is standardized to support those infants at risk for common yet specific conditions such as hypoglycemia, group B streptococcal (GBS) exposure, hepatitis B/HIV exposure, and maternal illicit substance exposure. Infants born to mothers with diabetes mellitus or those who are SGA, preterm, or LGA, as well as infants with birth asphyxia, are at risk for hypoglycemia. High-quality evidence to support the specifics of protocols for hypoglycemia screening is lacking but is presented here in generalized fashion. These infants should be observed closely for changes in level of consciousness (irritability, lethargy), apnea spells, poor feeding, hypothermia, hypotonia, tremors, or seizures.

Symptomatic infants should have a blood glucose level drawn immediately and should have feeding or other intervention as appropriate for their condition. Asymptomatic infants at risk for hypoglycemia should have a blood glucose level drawn in the first 30 minutes of life and begin frequent feeding (ideally at breast) during the first 2 hours of life, with at least one additional blood glucose evaluation during this time period.

The Centers for Disease Control and Prevention updated their recommendations for the prevention of perinatal GBS disease in November 2010. (11) In short, asymptomatic infants born to mothers who do not receive adequate prophylaxis for GBS should at a minimum have careful clinical observation with consideration of a limited screen (complete blood count with differential, blood culture) in some circumstances and 48 hours of observation. If adequate maternal intrapartum antibiotic prophylaxis (≥ 4 hours) has been administered, observation of the newborn in a medical setting may be as short as 24 hours. Symptomatic infants should have a full evaluation completed to rule out sepsis, including at minimum a complete blood count with differential, blood culture, and initiation of intravenous antibiotics. This algorithm is depicted in Fig 2.

Infants born to HIV- or hepatitis B-positive mothers should be bathed at birth (before any injections). The infant born to an HIV-positive mother should be formula-fed only, and zidovudine should be initiated by 12 hours of life. Consultation with a pediatric infectious disease specialist (either by phone or in person) is encouraged. Finally, infants born with maternal substance exposure, such as opiates, are at risk for neonatal abstinence syndrome (withdrawal). (12) An abstinence scoring system (Finnegan is one example) should be initiated with vital signs recorded at least every 4 hours, as well as the use of soothing techniques and frequent feeding (breastfeeding is ideal). High abstinence scores or abnormal vital signs should trigger transfer from a normal newborn nursery to a higher level of care with consideration for initiation of opiate therapy (eg, morphine). Social work and lactation consultations can be useful. In these and other instances, care pathways allow for immediate identification and implementation of standardized monitoring and intervention.

Family-Centered and Team-Based Care

The advantages of rooming-in to promote breastfeeding and family-centered rounds, allowing maximal time for the newborn to bond with his or her new family, are increasingly recognized in family-centered care. Pediatric clinicians should understand the importance of the team in caring for the child, acknowledging the important role

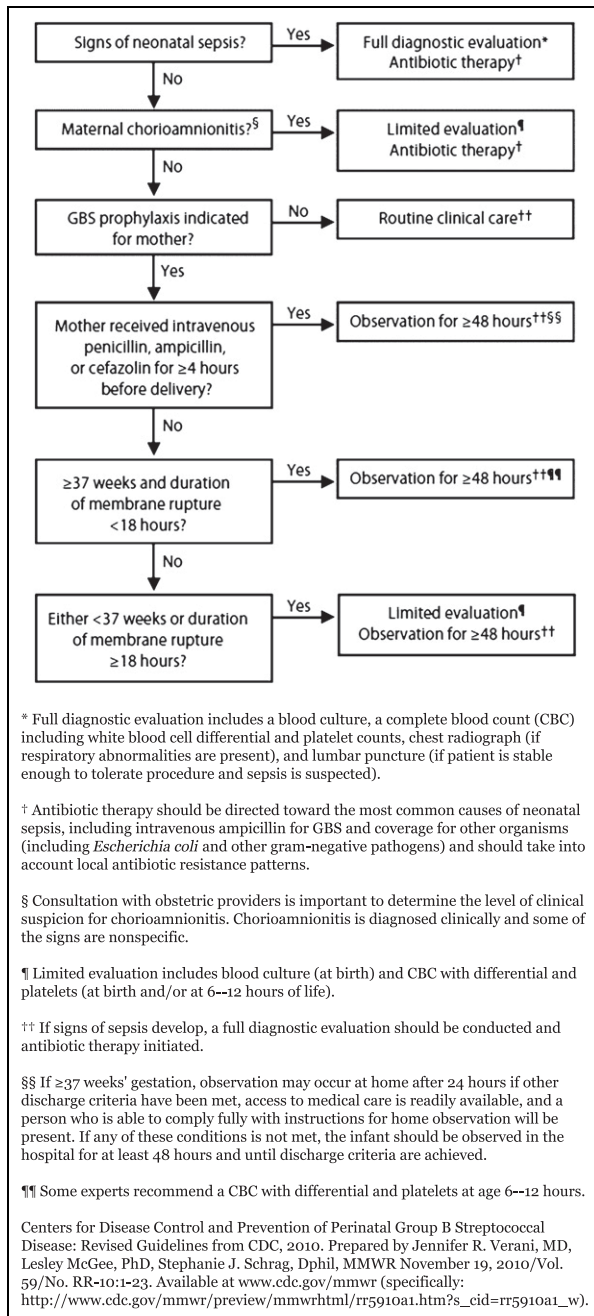


Figure 2. Algorithm for secondary prevention of early-onset group B Streptococcal (GBS) disease among newborns. Centers for Disease Control and Prevention guidelines/recommendations for the prevention of perinatal GBS disease.

various providers play during the birth hospitalization. Nurses, hearing screen specialists, phlebotomists, lactation consultants, obstetric providers, pediatric clinicians, doulas, case managers, social workers, and unit clerks all

contribute to the care of an individual child. The hospital stay often is standardized for healthy newborns but can require a large amount of care coordination for those newborns with special medical or social needs. Family-centered care plans should promote the well being of the family with streamlined, team-based care, minimizing interruptions and promoting parent-infant bonding.

If for any reason an infant must be separated from his or her parents for medical reasons, every effort should be made to maintain parent-infant bonding and promote breastfeeding. Mothers who are unable to breastfeed their infants should have access to high-quality breast pumps and providers skilled in lactation.

Normal Development in the First Days of Life The Newborn Examination

Ideally, a pediatric clinician's examination is completed in the first 24 hours after birth. Nursing colleagues often have assessed the infant fully before this examination, and their evaluations should be viewed as complementary. The initial examination serves the purpose of identifying anomalies, as well as reassuring parents about the health of their new infant. Education, sometimes termed "discharge teaching," should be regarded as a continuum, ideally initiated long before birth and continuing after birth with the first examination. Education may be reinforced best within the context of the examination itself, as the clinician identifies and discusses common findings, such as safe sleep positioning, skin and cord care, jaundice, and the voiding patterns common to the newborn.

The newborn's appearance often can raise questions from a new family who might find their infant does not appear as typically portrayed in the media. Skin findings such as acrocyanosis (a localized blue-purple discoloration of the hands and feet caused by sluggish peripheral circulation) and vernix (a white covering that protected the infant in utero), as well as vascular birthmarks, often are present. The head often is molded through the delivery process, and the face and eyelids can appear puffy or bruised. Milia (white keratin inclusions), sebaceous gland hyperplasia, slate grey patches on the back and buttocks, and newborn rashes such as erythema toxicum are other common findings.

The post-dates infant (>42 weeks) is often LGA but has a unique appearance. The skin can be markedly cracked, in particular at the wrists and ankles. If placental insufficiency is present, the subcutaneous tissues may appear wasted. LGA infants may have difficulty progressing through the birth canal and should be assessed for trauma with evaluation of the Moro reflex and grasp symmetry, as well as special attention to identify clavicular fractures.

The birth hospitalization provides an important time for education regarding normal infant behaviors and development. Parents should be reassured about the normal loss of weight that occurs in the first days and educated about the evolution and recognition of jaundice. In addition, the early newborn period is one of great physiologic transition for the infant. Care in subsequent examinations should be taken to examine the infant systematically for signs of ductal-dependent cardiac lesions, respiratory difficulties, feeding problems, and jaundice. Neurodevelopmental milestones, such as the newborn's ability to visually fixate, lift his or her head up when prone, and demonstrate reflexes such as the Moro or startle reflex and grasp and rooting reflexes, can be reviewed and demonstrated.

Breastfeeding

The benefits of breastfeeding cannot be overstated. A recent report concluded if 90% of families in the United States could comply with medical recommendations to breastfeed exclusively for 6 months, the United States would save billions of dollars per year and prevent an excess of 900 deaths, nearly all of which would be in infants. (13) This analysis did not include maternal benefits. Clear and unbiased information should be given to the family regarding the benefits of breastfeeding for both mother and infant. Individuals skilled in education and the assessment and management of breastfeeding problems should be readily available in the hospital and after discharge.

Many hospitals have established themselves as "Baby Friendly" according to the initiative by the World Health Organization (WHO) and United Nations Children's Fund, launched in 1991 to promote maternity centers as centers of breastfeeding support. The Baby Friendly designation requires a process involving application and institution of 10 specific steps, as seen in Fig 3. (14) (For a discussion of the views of the American Academy of Pediatrics [AAP] on the 10 steps to successful breastfeeding, refer to Lawrence RM, Lawrence RA. Breastfeeding: more than just good nutrition. *Pediatr Rev.* 2011;32:267–280.)

Every facility providing maternity services and care for newborn infants should:

- Have a written breastfeeding policy that is routinely communicated to all health care staff.
- Train all health care staff in skills necessary to implement this policy.
- Inform all pregnant women about the benefits and management of breastfeeding.
- Help mothers initiate breastfeeding within one half-hour of birth.
- Show mothers how to breastfeed and maintain lactation, even if they should be separated from their infants.
- Give newborn infants no food or drink other than breast milk, unless medically indicated.
- Practice rooming in, that is, allow mothers and infants to remain together 24 hours a day.
- Encourage breastfeeding on demand.
- Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
- Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.

From World Health Organization and United Nations Children's Fund (UNICEF). <http://www.unicef.org/newsline/tensteps.htm>. *Protecting, Promoting and Supporting Breastfeeding: The Special Role of Maternity Services*, a joint WHO/UNICEF statement published by the [World Health Organization](#)

Figure 3. Ten steps to successful breastfeeding. From the WHO and United Nations Children's Fund. Available at: <http://www.unicef.org/newsline/tensteps.htm>. For a discussion of the AAP's views on the 10 steps to successful breastfeeding, refer to Lawrence RM, Lawrence RA. Breastfeeding: more than just good nutrition. *Pediatr Rev.* 2011;32:267–280.

Increasingly, care delivery involves partners such as certified lactation consultants, midwives, and others skilled in the evaluation and management of common breastfeeding challenges and problems. The AAP has designed a curriculum for resident education in breastfeeding. (15) Training programs for pediatric, family medicine, and obstetrics and gynecology residents are increasingly incorporating breastfeeding medicine into standard resident curricula. At many institutions, pediatric and obstetric providers are experts in breastfeeding medicine.

Although exclusive breastfeeding provides optimal nutrition for the vast majority of infants, supplemental nutrition occasionally is medically indicated. In addition, some families will choose to feed their infants formula; this informed choice should be respected. There are times when, even with ample resources and desire, breastfeeding is unsuccessful. Maternal milk banks are being instituted increasingly for the benefit of all newborns, including premature infants, and may eventually provide an alternate and superior source of nutrition for those mother-infant dyads in whom breastfeeding is not an option but the

families would prefer not to use formula. Dextrose water and sterile water are to be avoided because their use may result in hyponatremia and other electrolyte disturbances. Ankyloglossia should be detected as part of the standard newborn evaluation, and any infant with breastfeeding difficulty should be reassessed for the possibility of this condition. Frenotomy is an option for those infants who have ankyloglossia and are experiencing breastfeeding difficulty.

The WHO recommends that children breastfeed for at least 2 years. The AAP and American Academy of Family Physicians recommend that infants be exclusively breastfed for 6 months and continue breastfeeding with appropriate complementary foods for at least 1 year. The US Public Health Service's "Healthy People 2020" set national goals of ~80% of infants breastfeeding at birth, ~60% at 6 months, and ~35% through 6 months to 1 year. (16) The United States fell short of the "Healthy People 2010" goals, let alone the "Healthy People 2020" and WHO recommendations. Recent national attention to breastfeeding through the Surgeon General's Call to Action to Support Breastfeeding (17) may bolster our progress on this front.

A 2007 systematic review of the effects of breastfeeding on maternal and infant health found for both mothers and infants in developed countries, many health benefits and effects of breastfeeding persist beyond the period of breastfeeding. (18) It has been established that breastfeeding mothers lose more weight in the immediate postpartum period and breastfed infants are thought to have lower risks of common conditions, such as acute otitis media, gastroenteritis, and atopic dermatitis. Children who were not breastfed may be at increased risk for obesity, asthma, diabetes, and childhood leukemia. Similarly, for mothers, not breastfeeding is associated with increased risk of postpartum depression, type 2 diabetes, and development of breast and ovarian cancers.

A 2010 publication further investigated mothers 45 to 58 years old who were free of clinical cardiovascular disease. (19) Each woman underwent an assessment of markers for subclinical cardiovascular disease. Compared with mothers who had breastfed children for at least 3 months, mothers who had not breastfed were more likely to have increased risk of vascular changes associated with future cardiovascular disease.

One of the most significant barriers to duration of breastfeeding in developed countries is early return to the workforce postpartum. Employers should provide a dedicated clean space for women to nurse or express milk, flexibility in work schedule, accommodations to store pumped milk, and a supportive environment to

achieve these goals. Many state and local governments have created legislation to support lactating women.

Jaundice

The development of jaundice or hyperbilirubinemia is a common phenomenon in newborn medicine. Most healthy newborns will have some degree of visible jaundice in the first week of life, but it is important to identify the rare infant who will go on to develop severe hyperbilirubinemia with its potential for bilirubin encephalopathy. Icterus progresses cephalocaudally, then to the extremities, typically peaking at 3 to 4 days. Visible jaundice in the first 24 hours always warrants investigation. Several factors contribute to cause hyperbilirubinemia. At birth, newborns have a robust hemoglobin level (14.0–22.5 g/dL) and increased red blood cell destruction.

Erythrocyte turnover results in the production of indirect bilirubin, which is conjugated in the liver by uridine diphosphate glucuronyltransferase. This enzyme is relatively immature in the healthy newborn, resulting in an indirect or unconjugated hyperbilirubinemia. Because it takes some time for breastfeeding to be established, the bilirubin that is conjugated can become unconjugated in the gut and re-presented by the process of enterohepatic circulation, contributing to indirect hyperbilirubinemia. Uridine diphosphate glucuronyltransferase enzymatic activity is deficient or reduced in some conditions (Crigler-Najjar syndrome, Gilbert syndrome) and polymorphisms have been identified in those of East Asian descent. This enzyme also is less functional in the presence of glucose-6-phosphate dehydrogenase deficiency in people of East Asian, Greek, and African descent.

The prevention of severe hyperbilirubinemia has been the subject of a great deal of attention and controversy. The Joint Commission has identified severe hyperbilirubinemia (defined as a bilirubin >30 mg/dL) as a reviewable sentinel event. (20) A sentinel event is any unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof. In 2004, the AAP published a practice guideline for management of hyperbilirubinemia. (21) In this policy statement, the authors recommended screening by a universal test measuring bilirubin *or* screening based on clinical risk factors.

Since this time, the prevention of bilirubin encephalopathy by universal screening has received an "I" rating by the US Preventive Services Task Force (USPSTF) (the evidence is insufficient to recommend for or against routinely providing the service). (22) Recently, however, the implementation of universal bilirubin screening was demonstrated to reduce the incidence of severe hyperbilirubinemia, a surrogate for bilirubin encephalopathy, in

a large cohort. (23) Phototherapy usage increased with institution of universal screening. Universal bilirubin screening with serum or transcutaneous bilirubin measurements now is commonplace before hospital discharge. Still, the evaluation and management of hyperbilirubinemia requires a high degree of clinical acumen, careful attention to detail, and a team-based approach to evaluation (Table 2). Clinical estimation of jaundice alone without history and risk stratification is prone to error.

Weight Loss

Weight loss in newborns is observed frequently, but normative data are not well characterized in the literature. In general, weight loss of >10% to 12% in the first postnatal week is a cause for concern and necessitates a thorough evaluation. Families should be reassured about this progression and can become preoccupied with a normal process because this is a value commonly measured, reported, and compared in the course of routine newborn care. Numerical weight loss of concern in the presence of a progressively improving feeding relationship should not drive supplementation. It is typically taught that newborns should regain their birth weight by 2 weeks after the birth, although many newborns reach this value much sooner if feeding is well established. Emphasis should return to the feeding relationship between mother and infant and the promotion of breastfeeding. A great deal of normative data collection and evidence-based research has yet to be completed in newborn care. A research collaborative regarding newborn care (Better Outcomes through Research for Newborns) is being developed in affiliation with the Academic Pediatric Association (<http://www.ambpeds.org/>) and promises to provide normative newborn data.

Voiding and Stooling Patterns

The infant typically passes a first meconium stool shortly after birth, often within the first hours and typically before 24 to 48 hours. These black, tarry, and sticky stools transition as the mother's human milk production increases. This transition typically occurs in a pattern, often from green/brown to a seedy, loose, mustard yellow appearance. It is not rare for an infant to pass stool with nearly every breastfeeding when the mother's milk is in because of the gastrocolic reflex signaling the colon to empty. When the passage of meconium stool is delayed, the provider can carefully recheck the infant's anus for the normal characteristic stellate pattern and continue to observe if the infant is feeding well without abdominal concerns. Delayed passage of stool beyond 48 hours can indicate serious problems, such as colonic obstruction from imperforate anus with or without fistula, meconium plug syndrome, or Hirschsprung disease. Imaging, including barium enema, and rectal suction biopsy as the diagnostic gold standard for Hirschsprung should be considered.

The infant's first urination nearly always occurs in the first 24 hours. Urine can be difficult to detect in the presence of frequent meconium stool, and the truly anuric infant is extremely uncommon. The evaluation of the anuric infant should include a reassessment of the pregnancy history, with special attention to decreased amniotic fluid (oligohydramnios) and anomalies of the urinary system on prenatal ultrasound that might indicate urinary obstruction. Feeding adequacy should be assessed and the notes reviewed to determine if the infant voided at delivery or elsewhere and the voiding was not recorded. One can then repeat the physical examination, paying particular attention to the genitalia and abdomen. If these

Table 2. Key Elements for Reducing Severe Hyperbilirubinemia

- Promote and support successful breastfeeding.
- Establish nursery protocols for the identification and evaluation of hyperbilirubinemia.
- Measure the total serum bilirubin or transcutaneous bilirubin level of infants jaundiced in the first 24 hours.
- Recognize that visual estimation of the degree of jaundice can lead to errors, particularly in darkly pigmented infants.
- Interpret all bilirubin levels according to the infant's age in hours.
- Recognize that infants <38 wks' gestation, particularly those who are breastfed, are at higher risk of developing hyperbilirubinemia and require closer surveillance and monitoring.
- Perform a systematic assessment for the risk of severe hyperbilirubinemia on all infants before discharge.
- Provide parents with written and oral information about newborn jaundice.
- Provide appropriate follow-up based on the time of discharge and the risk assessment.
- Treat newborns, when indicated, with phototherapy or exchange transfusion.

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findings are all normal, the infant can continue to be observed. A cotton ball placed between the labia or a bag may be applied to collect urine if there is concern that the urine was simply not observed. If there are continued concerns for anuria, catheterization, bladder and renal ultrasound with urologic consultation, and evaluation of renal function can be considered. Commercially available diapers now commonly have a stripe that changes color in the presence of urine, which helps identify small amounts of urine.

Parents often have questions about the appearance of newborn urine, which can initially be scant and darkly colored. This inquiry provides a good opportunity to discuss urate crystals (often termed “brick dust”) and vaginal discharge. Urate crystals look different from blood in the newborn’s diaper but can be confused. They tend to sit on the surface of the diaper and are iridescent and completely benign. Vaginal discharge can be clear, yellow, or white, and even blood-tinged as the female infant “withdraws” from maternal hormones.

A newborn should not be discharged until the passage of stool and urine can be documented.

Anticipatory Guidance, Screening Tests, and Routine Health Maintenance and Promotion

Anticipatory Guidance

The pediatric clinician’s goal should be to perform a complete assessment of the newborn while providing anticipatory guidance to the family. A sometimes overwhelming amount of information is given to a family during this brief hospitalization. Every effort to individualize, personalize, and teach in the context of the examination should be encouraged. Preventive health care and screening for both infant and mother are important components.

Anticipatory guidance always should include safe sleep positioning in which the infant is always placed on his or her back on a firm surface free of quilts, sleep positioners, or other soft objects, such as stuffed animals. During the hospitalization, safe sleep positioning should be modeled and promoted. The Back to Sleep campaign has resulted in a reduction in sudden infant death syndrome. (24)(25)

Breastfeeding and lack of exposure to tobacco are important, modifiable behaviors shown to reduce the risk of sudden infant death syndrome. Room but not bed sharing also is encouraged, and a pacifier can be offered once breastfeeding is established.

Parents often have questions about skin and cord care. The newborn infant does not require frequent bathing. Cleansers should be mild and the child should have sponge baths until the umbilical cord detaches. In the

past, antibiotic ointments, dyes, and alcohol have all been applied to the umbilical cord, but this practice is unnecessary. Parents should keep the umbilical stump dry and allow it to fall off naturally, generally in 10 to 14 days. Long, flexible but sharp fingernails often are a source of concern for the new family. With good lighting and when the child is quiet, the nails can be clipped, cut, filed, or torn.

Care of the uncircumcised penis requires little effort. It can be cleansed externally when regular bathing is established. Retracting the foreskin of an infant is discouraged because it will likely cause pain, bleeding, and even adhesions. Over time, the natural separation of the foreskin from the glans will occur. After puberty, boys can learn to retract and cleanse under the foreskin in the shower as a part of their daily hygiene. If circumcised, the penis should be kept clean and simple petroleum ointment applied to keep the newly exposed glans from adhering to adjacent skin or diaper.

Pediatric clinicians have an opportunity during the course of newborn care to educate families about the dangers of abusive head trauma and to normalize infant crying. Hospital-based interventions, such as the Period of Purple Crying, from which families receive information on newborn crying and abusive head trauma have proven effective in educating families (<http://www.purplecrying.info/>). Techniques to soothe the infant should be taught, but parents should be given realistic information about behavioral expectations.

Fever, hypothermia, poor feeding, lethargy, and tachypnea are nonspecific signs and symptoms but they can indicate serious bacterial infection during infancy. Knowing whom to call and when and where to seek care in the first months of life is an important part of anticipatory guidance provided in the hospital.

Necessary travel from the hospital to home affords the opportunity to provide car seat safety information to families, which can seem confusing and even overwhelming. Recent studies support recommendations to remain rear-facing for longer periods of time. (26) The AAP recommends that all infants should ride rear-facing, starting with their first ride home from the hospital. All infants and toddlers should ride in a rear-facing car safety seat until they are 2 years of age or until they reach the highest weight or height allowed by their car safety seat’s manufacturer. Certified car seat safety inspectors at the hospital or in the community provide adjunctive support.

Screening Tests

State-mandated screening tests typically include newborn metabolic screening and hearing screening, the specific

components of which may differ from state to state. Supportive statements have been issued by the Agency for Health Care Research and Quality for screening for congenital hypothyroidism, phenylketonuria, and hearing loss. The USPSTF gives an A recommendation (high certainty the net benefit is substantial) for screening for congenital hypothyroidism and phenylketonuria in all newborn infants. (27) The USPSTF gives a B recommendation (high certainty the net benefit is moderate or there is moderate certainty the net benefit is moderate to substantial) for screening for hearing loss in all newborn infants, citing good-quality evidence that early detection improves language outcomes. (28)

In addition to these tests, in 2009, the AAP concluded universal pulse oximetry screening at >24 hours incurs very low cost and risk of harm at those birthing sites that have on-site pediatric cardiovascular services. (29) Since then, screening for critical congenital heart disease (CCHD) was recommended by the US Health and Human Services Secretary's Advisory Committee on Heritable Disorders in Newborns and Children, but concerns regarding implementation prevented full support by the Secretary of Health and Human Services. More recently, an AAP work group found sufficient evidence supporting universal pulse oximetry screening to detect CCHD in well-infant and intermediate care nurseries. (30) To maximize positive predictive value, the screen should be accomplished at >24 hours, with screening values <96%, on the foot or >3% difference between the right hand and foot indicating the need for further evaluation. Oximetry should be considered an essential tool in the evaluation of any infant with a heart murmur, cyanosis, tachypnea, or signs of illness or poor feeding, as these could be presenting signs of undiagnosed congenital heart disease.

Some standard screening tests and other procedures are painful for the neonate. Pharmacologic and nonpharmacologic methods to relieve pain, as well as standardized assessments to assess pain, should be implemented. Breastfeeding and kangaroo care/skin-to-skin contact, as well as glucose/sucrose solutions, are options for reducing pain associated with routine minor procedures.

Vaccination

All newborns should receive vaccination at birth for hepatitis B. This vaccine is extremely effective in preventing hepatitis transmission. If the mother is hepatitis B surface antigen-positive, the infant should receive hepatitis B vaccine and hepatitis B immune globulin, administered in separate thighs, at birth. When the mother's hepatitis serology results are unknown, the infant should receive

the vaccine as soon as possible and within 12 hours of birth. The mother's serology results should be sought and the clinician has 7 days to administer hepatitis B immune globulin if serology results are positive for hepatitis B surface antigen. It is recommended that discharge be deferred until the serology results have been determined. Some institutions give the hepatitis B vaccine at the time of vitamin K administration, immediately after delivery.

Efforts should be made to provide influenza and tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed (Tdap) vaccination to postpartum mothers and to recommend or provide opportunities for other caregivers to receive these vaccinations. Vaccination of caregivers for influenza and pertussis effectively cocoons the vulnerable infant until he or she can be fully vaccinated. Families are often unaware of these risks and are accepting of adult vaccinations even when they have concerns about childhood vaccination.

Vitamin D

The AAP updated its vitamin D recommendations in 2008, increasing the minimum daily intake of vitamin D to 400 IU per day, beginning soon after birth. (31) This advice replaces a prior recommendation of 200 IU per day of vitamin D. In practice, all infants, whether formula fed or breastfed, are unlikely to be able to achieve the recommended intake through feeding and require supplementation. Children should continue to receive 400 IU per day of vitamin D through adolescence.

Discharge Readiness

Discharge readiness includes the completion of all newborn care tasks and parental education, a well-established feeding plan, and follow-up, in particular for the evaluation of jaundice and breastfeeding problems. The AAP defines all discharges before 48 hours as early discharge and recommends follow-up for these infants within 1 to 2 days, and in 72 hours when an earlier visit is not possible. (32) Access to care is still a problem and home-based care frequently is unavailable in our current health care delivery system. Discharge readiness checklists have been developed by the AAP and Bright Futures. (33)

In situations in which the newborn is at high risk for development of severe hyperbilirubinemia, feeding problems, or problems related to prematurity, or when a safe plan for discharge cannot be formulated, the infant should not be discharged until proper arrangements are made. Often there will be pressures related to length-of-stay parameters that have not been formulated with the at-risk infant in mind, but by third party payers. Perinatal

social workers and case managers may be instrumental in facilitating necessary steps for an unanticipated extended neonatal hospitalization. Pediatric clinicians must continue to advocate for newborns individually and collectively so they receive the care they require and deserve.

Quality Indicators in Newborn Care

National quality indicators for newborn care are being developed. As we move toward the measurement and reporting of quality care, residents who often are on the front lines in academic medical centers are becoming involved increasingly in the design and implementation of systems and processes to deliver quality care. Neonatal mortality, percentage of term infants with Apgar scores <7 or umbilical arterial pH <7.2, and NICU admission, as well as serious bacterial infections commonly are reported and tracked. Exclusive breastfeeding at discharge, hepatitis B immunization, and hepatitis B immune globulin (when indicated) are some obstetric and neonatal measures proposed by the National Quality Forum and others. Many hospitals and care systems are measuring and reporting newborn hearing screening referral rates, maternal Tdap administration rates, bilirubin measurements, and phototherapy usage.

The Medical Home Revisited

Communication with outpatient care providers regarding the events and results of the birth hospitalization and information gathered on the pregnancy and family history during the newborn's stay is the newborn care team's responsibility. Inpatient maternal and newborn care providers should see themselves as an extension of the medical home. Follow-up needs should be communicated electronically (ideally via an integrated electronic health record), and in some cases by direct telephone communication. Families also should receive information about the events of the hospitalization at the time of discharge in a format and language they understand. Information and documents to be relayed to the primary care provider should be identified clearly.

Postpartum depression affects up to 15% of all mothers and is likely underrecognized and undertreated. Similar to depression in pregnancy, the negative short- and long-term effects on child development are well established. Both the maternity care provider and the pediatric provider (if not the same clinician) have roles in screening for and treating postpartum depression. Communication between the two is essential. Treatment options include medications and psychotherapy. Barriers to successful treatment include access to mental health care and

mental health care professionals, concerns of breastfeeding mothers about exposure of the infant to antidepressant medication, knowledge and comfort of primary care providers in prescribing and monitoring medications, and financial and transportation barriers to care.

Special Circumstances

The Late Preterm Infant

Late preterm infants (typically defined as 34 0/7 to 36 6/7 weeks) deserve special consideration for their vulnerability. When thinking about these infants, it may be best when considering the gestational age to round it down to the last completed week rather than round it up (eg, a 36 5/7 week infant is described as a "36 weeker," emphasizing their immaturity). Late preterm infants are at high risk for respiratory distress, temperature instability, hypoglycemia, jaundice, feeding problems, and readmission after discharge. (10) Transportation of the low birth weight (<2500 g) and preterm infant deserves special consideration, and car seat testing for these infants has been proposed. Some institutions have personnel who have been certified in the evaluation of car seat installment available to the newborn nursery.

The preterm infant has higher fluid and caloric requirements and often has feeding difficulty. Insensible losses are increased with exposure to radiant warmers, during phototherapy, and because of the preterm infant's relative increase in body surface area. Mothers should begin pumping immediately after birth and lactation consultants are integral to the late preterm infant's care. Supplemental feeding frequently is necessary. Jaundice can present later, and late preterm infants cannot safely tolerate the same levels of bilirubin as a term infant. Careful attention to the feeding patterns and risk factors for jaundice are crucial to prevent pathologic hyperbilirubinemia.

Integrated Care and Nontraditional Births

Some infants are born at home or in out-of-hospital birth centers. Most of these births are term gestations in low-risk pregnancies. When evaluating infants born out-of-hospital for the first time, it is especially important to review which standard screening tests or medications (newborn metabolic screen, vitamin K, erythromycin, hearing screening) have been offered and completed, and coordinate care for those still needed. The first newborn outpatient visit often can be arranged to meet the needs of the mother and infant with coordination of care among obstetric, pediatric, and lactation providers. Home visits provide an excellent opportunity to provide this care in a family-centered fashion.

Summary

- The birth of an infant is one of the most memorable experiences a family shares. Pediatric health care professionals are privileged to participate in this experience and recognize it as a time to promote the health of the newborn and family.
- Ideally, a well-designed care system would be replete with comprehensive supports during the prenatal period, birth, and transition to home.
- Opportunities exist to improve the care we deliver with universal screening of all pregnant women; coordinated assessments of family health, including mental health; and access to coordinated supports and services for mother and infant.
- If 90% of US families could comply with medical recommendations to breastfeed exclusively for 6 months, it is estimated the United States would save billions of dollars per year and prevent more than 900 deaths, nearly all of which would be in infants.
- All infants, whether breastfed or formula fed, should receive 400 IU supplemental vitamin D.
- Influenza and Tdap vaccination of postpartum mothers and other caregivers helps cocoon the vulnerable infant from influenza and pertussis until he or she can be fully vaccinated.
- When children reach the highest weight or length allowed by the manufacturer of their infant-only seat, they should continue to ride rear-facing in a convertible seat. It is best for children to ride rear-facing as long as possible to the highest weight and height allowed by the manufacturer of their convertible seat.

Parent Resources From the AAP at HealthyChildren.org

The reader is likely to find material to share with parents that is relevant to this article by visiting this link: <http://www.healthychildren.org/English/ages-stages/baby/pages/default.aspx>.

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PIR Quiz

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Per the 2010 revision of the American Medical Association (AMA) Physician's Recognition Award (PRA) and credit system, a minimum performance level must be established on enduring material and journal-based CME activities that are certified for *AMA PRA Category 1 Credit™*. In order to successfully complete 2012 *Pediatrics in Review* articles for *AMA PRA Category 1 Credit™*, learners must demonstrate a minimum performance level of 60% or higher on this assessment, which measures achievement of the educational purpose and/or objectives of this activity.

Starting with 2012 *Pediatrics in Review*, *AMA PRA Category 1 Credit™* can be claimed only if 60% or more of the questions are answered correctly. If you score less than 60% on the assessment, you will be given additional opportunities to answer questions until an overall 60% or greater score is achieved.

1. Which of the following conditions in neonates should prompt an immediate evaluation by a healthcare provider?
 - A. Brick-colored crystals in the diaper.
 - B. Failure to pass stool in the first 12 hours of life.
 - C. Jaundice in the first 24 hours of life.
 - D. Weight loss of 5% in the first week.
 - E. White vaginal discharge.

2. You are counseling new parents on their son's care before his discharge at 2 days old. His newborn course has been normal except for some mild spitting up after feeds. The parents have opted not to have him circumcised before discharge. Which of the following is the best advice?
 - A. He may have dextrose water between breastfeeding if he appears hungry.
 - B. He should sleep on his abdomen because he has gastroesophageal reflux.
 - C. They should apply daily antibiotic ointment to his umbilical stump.
 - D. They should retract the foreskin daily to prevent infection.
 - E. They should seek medical care immediately if he has a fever $>100.4^{\circ}$.
3. You are attending the caesarian delivery of a 39 weeks' gestation boy. Upon delivery, his heart rate is 90 beats per minute and he is breathing normally. He shows flexion of all extremities and has good muscle tone and a strong cry. His lips are pink but his hands and feet are bluish. What Apgar score would you assign at 1 minute?
 - A. 6.
 - B. 7.
 - C. 8.
 - D. 9.
 - E. 10.
4. Which of the following statements regarding maternal and neonatal care is true?
 - A. Apgar scores are assigned to predict neurologic development.
 - B. Epidural anesthesia is associated with an increased risk of fetal bradycardia.
 - C. Infants who are born via vaginal delivery have an increased risk of transient tachypnea of the newborn.
 - D. Only infants who are exclusively breastfed require vitamin D supplementation.
 - E. Pediatricians play a role in recognizing postpartum depression in mothers.
5. At a prenatal visit, a mother asks you about the effects breastfeeding might have on her own health. Which of the following would be a true consequence if she breastfeeds her baby?
 - A. She is at higher risk for developing type 2 diabetes.
 - B. She is less likely to develop ovarian cancer.
 - C. She is likely to put on more weight.
 - D. She is more likely to develop breast cancer.
 - E. She will be at higher risk for becoming depressed.

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